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SYSTEMATIC POSITION OF *SIBATANIOZEPHYRUS* AND DESCRIPTION OF A NEW SPECIES FROM TAIWAN (LYCAENIDAE: THECLINAE)

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ABSTRACT. The systematic position of the *Fagus*-feeding genus *Sibataniozephyrus* was examined using cladistic methodology. This formerly monotypic genus, confined to eastern Asia, previously was lumped with *Quercusia*, a monotypic genus confined to Europe. If the two genera are combined, they form a paraphyletic taxon in the preferred cladogram. Hence, this analysis provides support for maintaining the two as distinct genera. *Sibataniozephyrus kuafui*, new species, is described and illustrated from Taiwan. The discovery of the new species has interesting biogeographic interpretations.

Additional key words: *Quercusia*, *Fagus*-feeding, Theclini, China, Japan.

Members of *Sibataniozephyrus* are moderate sized (forewing length 15.0–18.6 mm) Theclini "hairstreak" butterflies that live exclusively in beech (*Fagus* spp.; Fagaceae) forests. Males spend the majority of their adult life flying high around the canopy of beech trees, showing their magnificent metallic blue colors. In contrast, females sit motionless most of the time, perched in the vegetation, with their somber brown wings folded. The larvae of *Sibataniozephyrus* feed exclusively on soft new foliage of the host, which is available only in early spring. As a result of the narrow availability of appropriate larval food, members of *Sibataniozephyrus* are univoltine.

The taxonomic status of *Sibataniozephyrus* has been the subject of considerable controversy. Prior to the discovery of the new species described below, the genus was considered monotypic, accommodating the single species *S. fujisanus* (Matsumura), which is restricted to Japan. On the basis of similarities in the female genitalia, *Sibataniozephyrus* was lumped by Shirôzu and Yamamoto (1956) with the monotypic genus *Quercusia*, which includes the single species *Q. quercus* (Lineaus) restricted to Europe. Shirôzu and Yamamoto (1956) did not dismiss the possibility that the two may require different genera. Although the female genitalia of the two are similar, other characters (i.e., male genitalia and relative length of the discoidal cell of the forewing) are moderately divergent, suggesting that the two genera may not form a monophyletic lineage. This taxonomic difficulty has been manifested in nearly every treatment that included *Sibataniozeph-*

TABLE 1. Number of species of *Fagus*, *Sibataniozephyrus*, and Theclini represented in the world with special reference to Asia: EU, Europe; AC, mainland China; AT, Taiwan; AJ, Japan; NA, North America. (Data resources: D'Abrera 1993, Inomata 1986, Makino 1989, Shirôzu 1961, Walters, 1964, Zhang 1987.)

	Fagus	*Sibataniozephyrus*	Theclini
EU	2	0	3
AC	6	0	58+
AT	1	1	25
AJ	2	1	24
NA	1	0	3

yrus since that time (e.g., Kawazoé & Wakabayashi 1976, Saigusa 1983, Fukuda et al. 1984, D'Abrera 1993).

In 1986 Inomata (1986) proposed the genus *Sibataniozephyrus* for the species *fujisanus,* but provided no phylogenetic analyses to support this placement. Indeed, no taxonomic level within the Theclini has been the subject of cladistic analysis to elucidate the phylogeny.

Sibataniozephyrus represents the only *Fagus*-feeding member of Theclini. Because the distributional centers of both *Fagus* and Theclini are located in China (Table 1), where the *Fagus*-feeding behavior likely evolved, it seems unusual that *Sibataniozephyrus* was absent from there. Intrigued by this incongruity, we began extensive collecting in *Fagus* forests on Taiwan in 1986. These efforts finally produced an undescribed species of *Sibataniozephyrus* in 1992.

MATERIALS AND METHODS

A cladistic analysis of *Sibataniozephyrus* and its nearest relatives was conducted in an attempt to elucidate the relationship between *Quercusia* and *Sibataniozephyrus*. In addition to these two, the following genera were included in the cladistic analysis: *Chrysozephyrus* Shirôzu & Yamamoto, *Thermozephyrus* Inomata, *Neozephyrus* Sibatani & Ito, *Favonius* Sibatani & Ito (divided into two OTU's because it contains a remote member *F. saphirinus* Staudinger), and *Austrozephyrus* Howarth. Selection of these genera was based primarily upon studies by Shirôzu and Yamamoto (1956) and Eliot (1973). Two remote genera, *Japonica* Tutt and *Euaspa* Moore, were included in the analysis as outgroups. More than one outgroup was used because multiple outgroups will generate the most parsimonious cladogram globally (Maddison et al. 1984). *Japonica* was selected because its members retain a large number of ancestral characters (Shirôzu & Yamamoto 1956). *Euaspa* was chosen because the systematic position of *Austrozephyrus* was suspected to have common rooting with this genus (Saigusa 1983).

Whenever possible, we used the type species of the above genera.

When insufficient material was available for the type species, we used specimens of closely related species in the same genus. For selection of appropriate species and characters for the analysis, we consulted the following literature: Shirôzu and Yamamoto (1956), Shirôzu (1960) and Shirôzu and Saigusa (1970). Together, these publications contain detailed illustrations of numerous species of the genera examined in the cladistic analysis. All of the species substituted for the type species shared the same character states with the type species for all of the characters used in the analysis. Terminology for genitalic structures used in the character analyses and descriptions follow Klots (1970).

Material examined (type species of each genus in bold):

Chrysozephyrus disparatus (Howarth) (1♂, Taiwan); *C. duma* (Hewitson) (1♂, Nepal); *C. kabrua* (Tytler) (2♂, Taiwan); *C. nishikaze* (Araki & Sibatani) (1♂, Taiwan); *C. rarasanus* (Matsumura) (6♂, Taiwan); ***C. smaragdinus*** (Bremer) (4♂1♀, Japan); *C. souleanus* (Riley) (2♂2♀, China); *C. yuchingkinus* Murayama & Shimonoya (2♂, Taiwan).

Thermozephyrus ataxus (Doubleday & Hewitson) (3♂3♀, Japan; 1♂1♀, Taiwan).

Neozephyrus japonicus (Murray) (3♂, Japan); *N. helenae* Howarth (1♀, China); *N. taiwanus* (Wileman) (3♂1♀, Taiwan).

Sibataniozephyrus fujisanus (Matsumura) (3♂8♀, Japan); *S. kuafui* Hsu & Lin (24♂1♀, Taiwan).

Quercusia quercus (Linnaeus) (2♂2♀, France; 2♂1♀, Belgium).

Favonius jezoensis (Matsumura) (6♂2♀, Japan); *F. latifaciatus* (Shirôzu) (2♂1♀, Japan); ***F. orientalis*** (Murray) (3♂, Japan); *F. saphirinus* (Staudinger) (4♂1♀, Japan); *F. taxila* (Bremer) (4♂, Japan).

Austrozephyrus obsolon (Hewitson) (2♂4♀, Malaya).

Japonica lutea (Hewitson) (1♂, Japan; 2♂5♀, Taiwan); ***J. saepestriata*** (Hewitson) (4♂8♀, Japan; 1♂1♀, China).

Euaspa milionia (Hewitson) (2♂, Taiwan; 1♀, Nepal).

The cladistic analysis was performed primarily using Hennig 86 version 1.5 with implicit enumeration option (Farris 1988). Hennig 86 does not allow multiple outgroup assignment, so only *Japonica* was assigned as outgroup, although *Euaspa* was retained in the analysis. *Euaspa* was expected to be linked with *Austrozephyrus* if they are more related to each other than to the rest of the ingroup members. PAUP version 2.4 also was employed to check the results, using global branching swapping and multiple parsimony options (Swofford 1985). PAUP allows multiple assignments of outgroups, so both *Japonica* and *Euaspa* were regarded as outgroups in that analysis.

Characters Used to Construct Hypothetical Phylogeny for *Sibataniozephyrus* and Its Related Genera

Because of the uniform external features among these genera, genitalic structures comprised most of the characters used in the analysis. Multiple state characters were used to construct the original data matrix. Hennig 86 allows two-way transformation series; the character coding in the data matrix (Table 2) and the character descriptions given below

TABLE 2. Data matrix. Column = characters, 0 = plesiomorphic state, 1, 2, 3, 1′, 2′ = derived states; row = genera: EUA, *Euaspa* (outgroup); JAP, *Japonica* (outgroup); CHR, *Chrysozephyrus*; THE, *Thermozephyrus*; NEO, *Neozephyrus*; SIB, *Sibataniozephyrus*; QUE, *Quercusia*; FAV, *Favonius* excluding *F. saphirinus*; FAS, *Favonius saphirinus*; AUS, *Austrozephyrus*.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
JAP	0	0	0	1′	0	0	0	0	0	0	0	0	0	0	0	0	0
EUA	0	0	0	0	0	0	0	0	0	1	0	1′	0	0	1	0	0
CHR	2	1	0	0	0	0	0	0	0	0	0	1	2	1	1	0	1
THE	3	1	0	0	0	0	0	0	1′	0	0	1	2	1	1	0	1
NEO	1	1	0	1	0	0	0	0	0	0	1	1	2	1	1	0	1
SIB	0	1	0	0	1	0	1	1	0	0	0	0	2	0	1	0	1
QUE	2′	1	0	2′	0	0	1	0	1	0	0	0	1	0	1	1	1
FAV	1′	1	0	2	0	0	0	0	2	0	1′	0	2	1	1	0	1
FAS	0	1	0	2	0	0	0	0	2	0	1′	0	2	1	1	1	1
AUS	0	2	1	0	0	1	0	0	0	1	0	1	2	1	1	0	1

are two-way. When PAUP was used, all the characters with two-way transformation series were divided into two characters with one-way transformation series.

We polarized the characters mainly by outgroup comparisons. When the plesiomorphic state was not assigned to outgroups, explanations are followed by the character descriptions. In all character descriptions, the presumed plesiomorphic state (0) is listed first, followed by a transformation series in one direction (1, 2, . . .) and a transformation series in another direction (1′, 2′, . . .) respectively, when necessary.

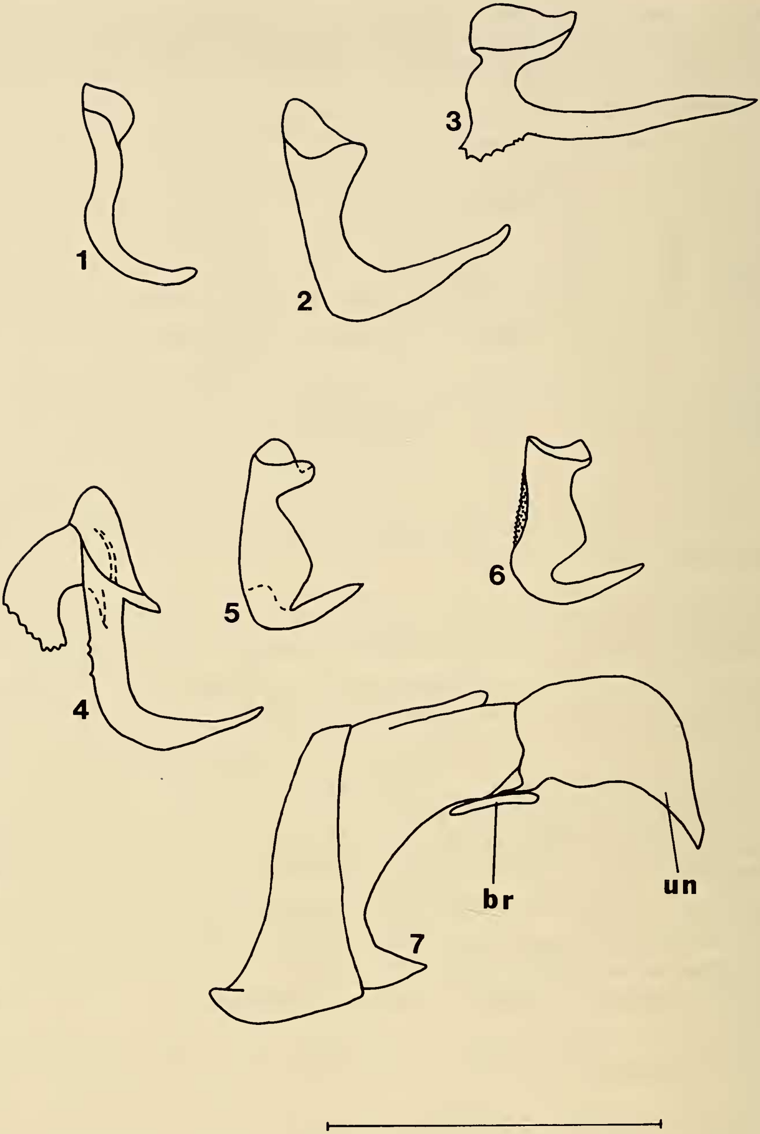
1. Brachium on tegumen: smooth and simple (Figs. 1, 24, 29) (0); smooth but flattened (Fig. 2) (1); serrated anteriorly (Fig. 3) (2); similar to state 2 but with additional large serrated lobe extending anteriorly (Fig. 4) (3); smooth, with basal half enlarged (Fig. 5) (1′); similar to state 1′ but bearing numerous minute teeth in front (Fig. 6) (2′).

2. Articulation of brachium with tegumen: double-articulated (0); single-articulated (1); brachium fused with tegumen, no articulation (2).

3. Brachium general shape: hook shape (Figs. 1–6) (0); rod shape (Fig. 7) (1).

4. Phallus structure: symmetrical with no special modification (Fig. 8) (0); generally symmetrical but bearing an elongate dentate sclerite at the right side of aedeagus (Fig. 10) (1); similar to state 1 but dentate sclerite reduced with left side of aedeagus also reduced (Fig. 11) (2); caudal end of aedeagus slightly asymmetrical, weakly sclerotized (Fig. 12) (1′); caudal end of aedeagus strongly asymmetrical, forming complicated, heavily sclerotized structure (Fig. 13) (2′).

The character state (1′) of *Japonica* was considered derived because



FIGS. 1–6. Left brachium: **1**, *Japonica saepestriata*; **2**, *Neozephyrus japonicus*; **3**, *Chrysozephyrus smaragdinus*; **4**, *Thermozephyrus ataxus*; **5**, *Favonius orientalis*; **6**, *Quercusia quercus* (scale line = 1 mm).

FIG. 7. Lateral view of sclerites of 9 + 10 genitalic segments with modified left brachium attached in *Austrozephyrus obsolon*; br, brachium, un, so-called "uncus" with its homology with the other uncus-like structures found in the other Theclini uncertain (scale line = 1 mm).

the simple, symmetrical phallus (0) is found commonly in ingroup genera and also in the other outgroup genus *Euaspa*.

5. Phallus upcurved: no (Fig. 9) (0); yes (Figs. 25, 30) (1).

6. Aedeagus twisted: no (Figs. 8, 10–13) (0); aedeagus twisted 90° toward the left side (Fig. 14) (1).

7. Juxta shape: U- or V-shaped (Figs. 15, 16) (0); modified into a simple plate (Figs. 17, 26, 31) (1).

8. Harpal region of valva: no process (Figs. 18–21) (0); bearing a prominent elongate process proximately (Figs. 27, 32) (1).

9. Ampulla of valva: not serrated (Figs. 18, 27, 32) (0); finely serrated mesad (Fig. 19) (1); strongly serrated mesad (Fig. 20) (2); modified into a large erect, dentate tooth (Figs. 21, 22) (1′).

10. X tergite: uncus absent (Figs. 23, 28) (0); so-called "uncus" (with homology uncertain) in various forms present (Fig. 7) (1).

The plesiomorphic state was not assigned to the so-called "uncus" found in *Euaspa* because this uncus-like structure is found only in *Austrozephyrus* in the ingroup and its homology with *Euaspa* was uncertain. This decision is supported by the fact that both Ogyrini and Arhopalini, the most likely sister groups of Theclini, lack an uncus (Eliot 1973).

11. Two signa on corpus bursa: small, rounded, invaginated inwards into a spine (Figs. 35, 36, 38) (0); extended enormously into a spiny, elongate stripe (Fig. 34) (1); lost (Fig. 33) (1′).

12. Lamella postvaginalis of sterigma: bilobed, separated into two pieces (Figs. 33, 36, 38) (0); modified into a single rectangular plate, sometimes with complicated structures (Fig. 34) (1); modified into a double layered plate, with the ventral layer elongate and rectangular while the dorsal layer bifid, finger-like, and projecting posteriorly (Fig. 35) (1′).

The character state (1′) of outgroup *Euaspa* is apparently not plesiomorphic since this state is specific to *Euaspa* and not found anywhere else in Theclini.

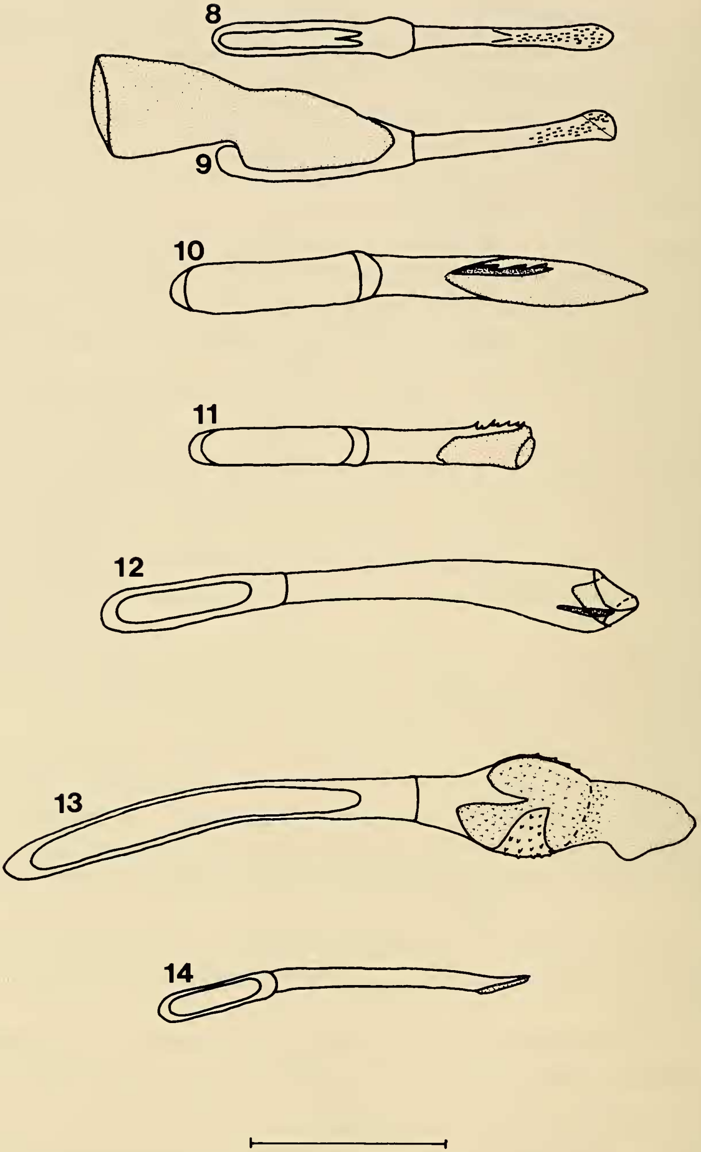
13. Sexual dichromatism: absent (0); present, male with specialized purple metallic scales on upperside of the wings, female dull-colored (1); similar to state 1 but with green/blue metallic scales (2).

14. Female polymorphism: absent (0); present, individual with blue patch, orange spots, or both present or absent on forewing upperside (1).

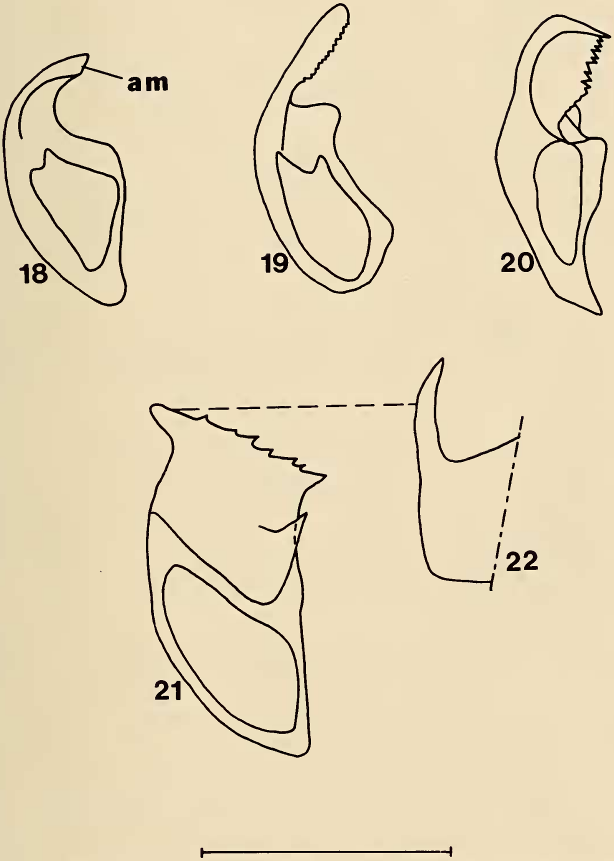
15. Foretarsus: segmented in both sexes (0); rudimentary in male (1).

16. Forewing venation: M1 forked with R3 away from the base (0); M1 forked with R3 at the base (1).

17. Male eyes: naked or sparsely hairy (0); densely hairy (1).

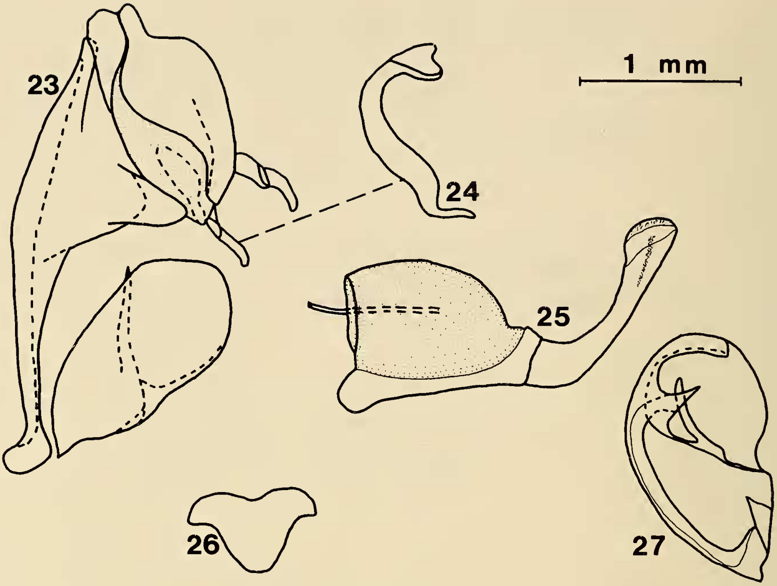


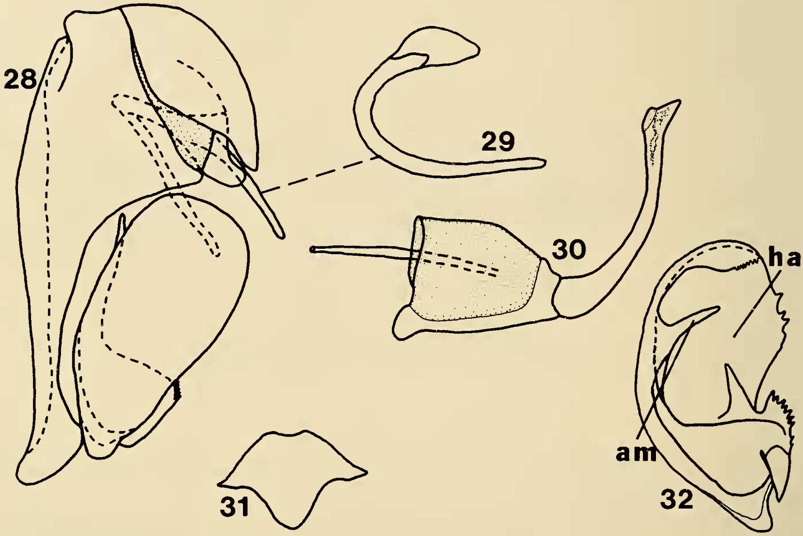
FIGS. 8–14. Phallus: **8,** *Chrysozephyrus smaragdinus* (dorsal view); **9,** *Chrysozephyrus smaragdinus* (ventral view); **10,** *Neozephyrus japonicus*; **11,** *Favonius orientalis*; **12,** *Japonica saepestriata*; **13,** *Quercusia quercus*; **14,** *Austrozephyrus obsolon* (scale line = 1 mm).



FIGS. 15–17. Juxta: **15,** *Japonica saepestriata*; **16,** *Chrysozephyrus smaragdinus*; **17,** *Quercusia quercus* (scale line = 1 mm).

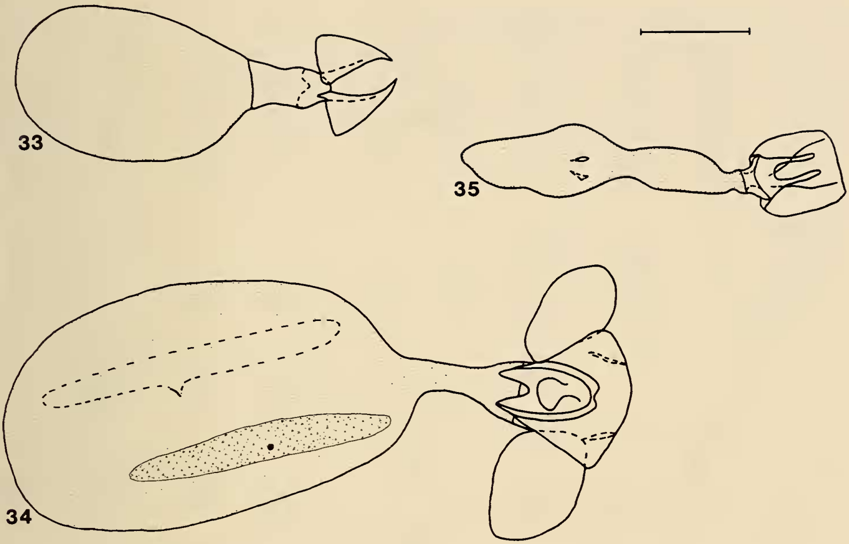
FIGS. 18–22. Right valva: **18,** *Chrysozephyrus smaragdinus*; **19,** *Quercusia quercus*; **20,** *Favonius orientalis*; **21,** *Thermozephyrus ataxus*; **22,** Lateral view of right ampulla of *Thermozephyrus ataxus* (scale line = 1 mm).





FIGS. 23–27. Male genitalia of *Sibataniozephyrus fujisanus* (Matsumura): **23,** Lateral view of sclerites of 9 + 10 genitalic segments with brachia and left valva attached; **24,** left brachium; **25,** phallus; **26,** juxta; **27,** dorsal view of right valva.

FIGS. 28–32. Male genitalia of *Sibataniozephyrus kuafui*, new species: **28,** Lateral view of sclerites of 9 + 10 genitalic segments with brachia and left valva attached; **29,** left brachium; **30,** phallus; **31,** juxta; **32,** dorsal view of right valva.



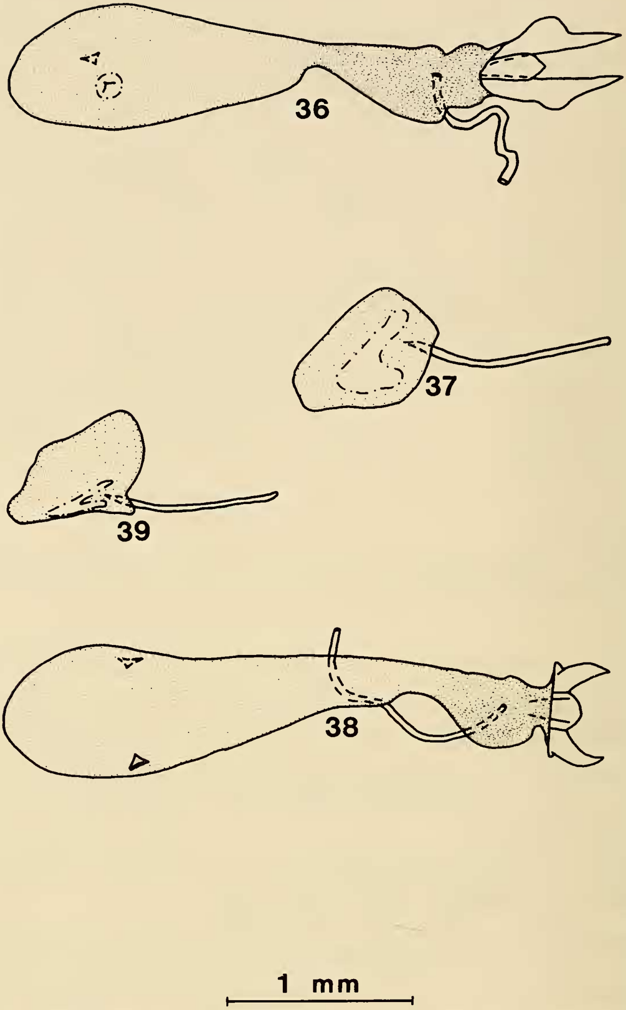
Figs. 33–35. Female genitalia: **33**, *Favonius jezoensis*; **34**, *Neozephyrus taiwanus*; **35**, *Euaspa milionia* (scale line = 1 mm).

Results of the Cladistic Analyses

Two minimum length trees (Figs. 40, 41) were derived from the data set using Hennig 86 each with CI = 0.78. Two equally parsimonious trees of the same topologies as above were found using PAUP each with CI = 0.81. The ingroup topology did not change when the outgroups were removed.

The high CI values of the trees (CI = 0.78/0.81) indicate that the data matrix has relatively little homoplasy.

Austrozephyrus, considered by Saigusa (1983) to be closely related to *Euaspa*, forms a monophyletic clade with *Quercusia* lineage distinct from *Euaspa*, supported by characters 2, 13, and 17 (Figs. 40, 41). Thus it should be retained within the ingroup. Whether *Sibataniozephyrus* should be treated as congeneric with *Quercusia* is still somewhat disputable. Of the two equally parsimonious trees produced, one suggests a monophyletic relationship between *Sibataniozephyrus* and *Quercusia* (Fig. 40). Nevertheless this tree seems less likely to reflect the true phylogeny because the only synapomorphy for the two genera is a platelike juxta (character 7). With the rest of the ingroup and outgroup genera possessing a V- or U-shaped juxta, the platelike juxta found in *Sibataniozephyrus* and *Quercusia* may reflect the loss of function owing to the specialized phallus of the two genera. The strongly upcurved phallus of *Sibataniozephyrus* and the elongate phallobase and enlarged



FIGS. 36–37. Female genitalia of *Sibataniozephyrus fujisanus* (Matsumura): **36**, Corpus bursa with stigma; **37**, papilla analis with apophysis posterioris.

FIGS. 38–39. Female genitalia of *Sibataniozephyrus kuafui*, new species: **38**, Corpus bursa with stigma; **39**, papilla analis with apophysis posterioris.

aedeagus of *Quercusia* probably function to stabilize the phallus in the male genitalic complex. Thus it is our view that the platelike juxta can not be regarded unequivocally as a synapomorphy for these two genera. Furthermore, this tree suggests the most derived state of character 13 (i.e., metallic blue/green color in male) evolved twice: once on the lineage of *Sibataniozephyrus* and the other on the lineage leading to

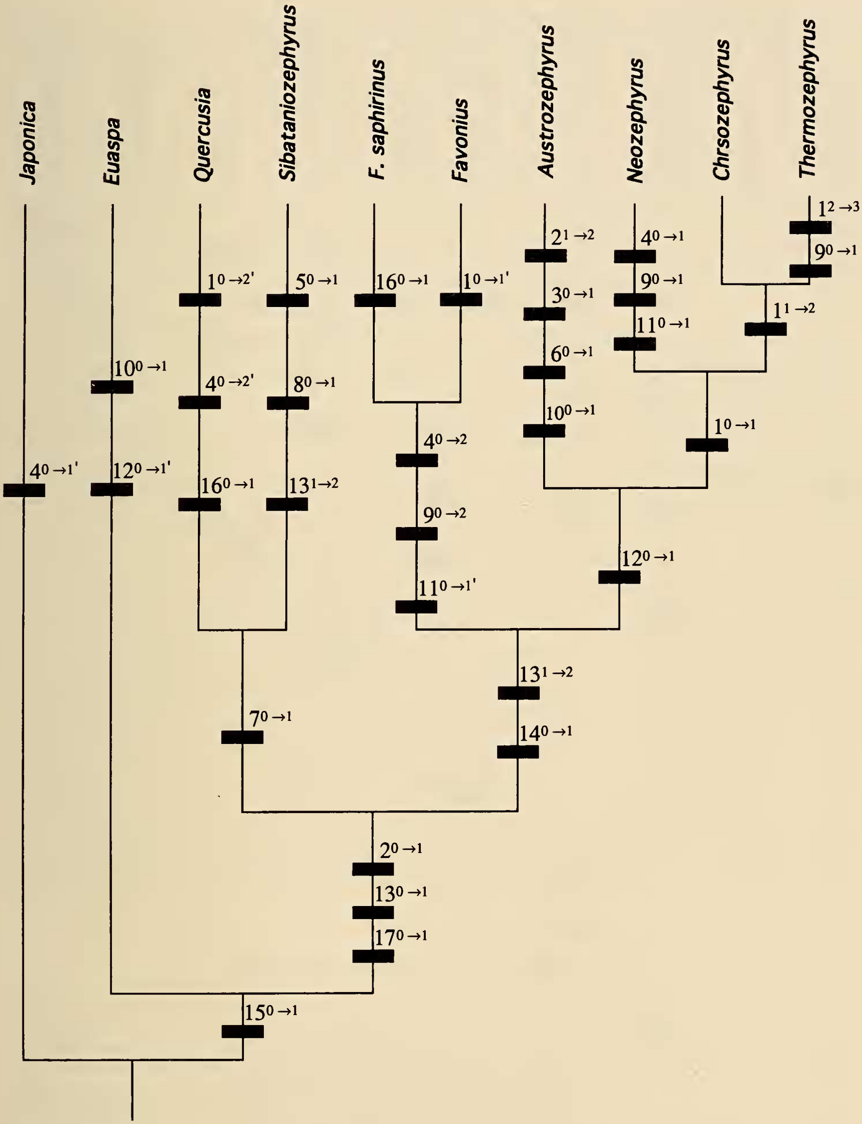


FIG. 40. A cladogram less likely to reflect the true phylogeny of *Sibataniozephyrus* and possibly related genera (produced primarily by Hennig 86 but with slight modification at the base since character 15 is more logical to have segmented tarsus assigned as plesiomorphic state).

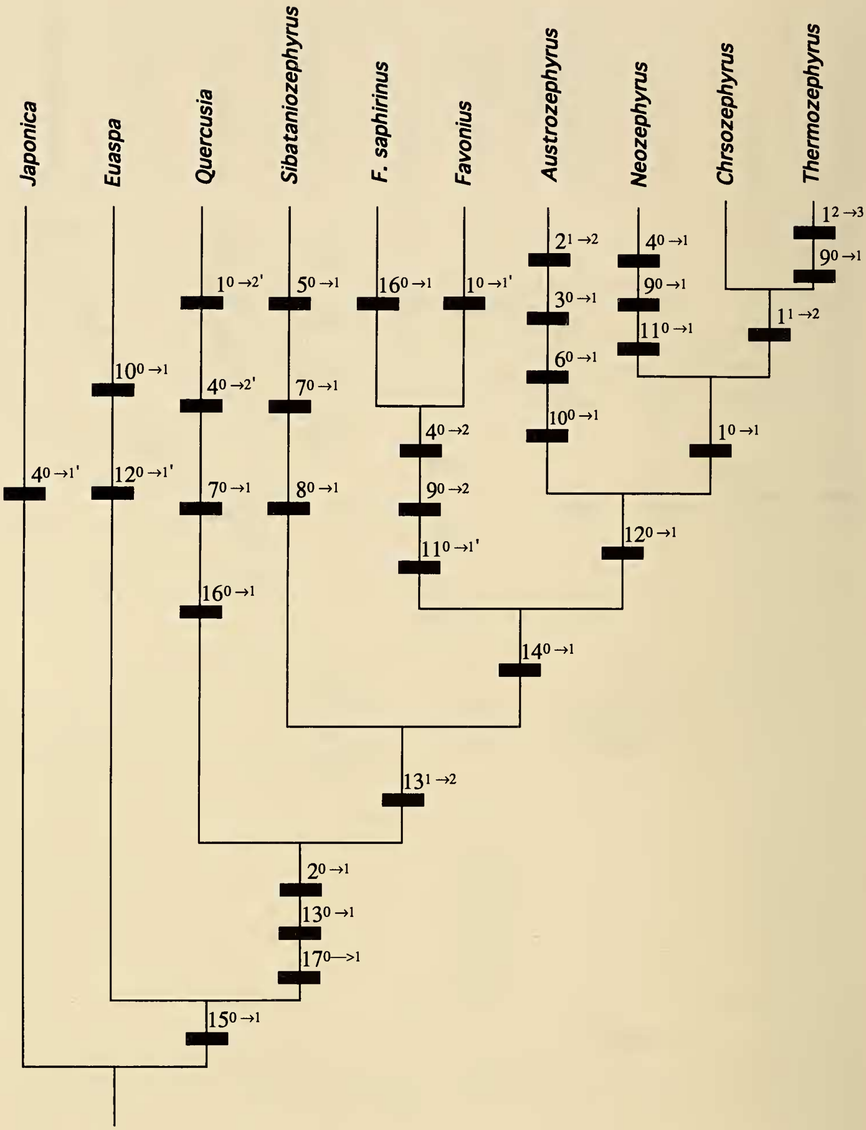


FIG. 41. Proposed phylogeny based upon the preferred cladogram for *Sibataniozephyrus* and possibly related genera (produced primarily by Hennig 86 but with slight modification at the base since character 15 is more logical to have segmented tarsus assigned as plesiomorphic state).

the rest of the metallic green/blue-winged genera. However, because *Sibataniozephyrus* and the majority of the other blue/green-winged genera are found in the same geographical range in Asia and not found in the other continents where Theclini also are present, the metallic green/blue scales probably evolved only once. The cladogram shown on Fig. 41 shows a paraphyletic relationship between *Quercusia* and *Sibataniozephyrus*. Both genera have a few autapomorphies which justify their separation as genera in the annotated Linnaean classification conventionally used. *Quercusia* possesses characters 1, 4, 16 and *Sibataniozephyrus* characters 5 and 7.

It is our view that *Sibataniozephyrus* should be recognized as an independent genus and the superficially similar platelike juxta is homoplastic. Based on the preferred proposed phylogeny, the purple *Quercusia* is a sister group of all the other genera having metallic green or blue scales in the male. All these green/blue-winged genera are found only in east and southeast Asia; *Quercusia* and the green/blue-winged genera are allopatric. It seems that *Quercusia* diverged early in the evolutionary history of these groups and extensive evolutionary change took place between the two lineages. *Sibataniozephyrus* also diverged early and underwent significant specialization as it obtained its unique niche of *Fagus*-feeding, a feature found nowhere else in Theclini. These specializations probably occurred after the lineage of the common ancestor of the green/blue-winged genera already split from the lineage of the ancestor of *Quercusia*, which feeds on a wide range of plants in different families but is not known to feed on European *Fagus* (Shirôzu 1961, Carter 1982). It is apparent that symplesiomorphic characters shared by these two lineages of Theclini led to Shirôzu and Yamamoto's (1956) decision to treat them as congeneric.

TAXONOMY

Sibataniozephyrus Inomata, 1986

Sibataniozephyrus Inomata 1986:120.

Type-species. *Zephyrus fujisanus* Matsumura, 1910, by monotypy. Gender masculine.

Diagnosis. Moderate sized, diurnal butterflies (FW length 15.0–18.6 mm). **Head:** Hairy, clothed with upraised, black and grayish white hairs on vertex and frons, appressed scales on occiput, a white rim surrounding the eye; eye semi-oval, hairy; labial palpus hairy, porrect, pointed, projecting ahead of plane of front; maxillary palpus reduced, not visible; proboscis unscaled; antenna smooth-scaled, with projecting setae at nudum in both sexes, antennal length in male longer than in female. **Thorax:** Grayish white dorsally, tinged with metallic structural colors under reflection of light in male, uniformly brown in female; white ventrally, legs white, banded with dark brown on tarsi. **Abdomen:** Dark brown dorsally, white ventrally. **Forewing:** Termen nearly straight, costa curved; 11 veins, R4 + 5 and M1 both forked with R3, the forking points dividing R3 into three nearly equal long parts; upperside scaling shining metallic with a dark dull margin in male, uniformly dark in female, both sexes with underside markings visible by transparency; underside scaling white to pale brown with series of dark submarginal spots between two transverse lines; a prominent dark discal band, a white patch between this band and the submarginal spot system regardless of ground color. Fringe white. **Hindwing:** Slender "tail" from Cu2; 9 veins all separate; upperside scaling shining metallic with a dark margin always broader than that of forewing in male, uniformly dark in female, both sexes with a very fine white outline along termen, underside markings visible by transparency; underside scaling similar to that of forewing but with a large yellow or orange tornal patch with black rounded spot in Cu1, and a black irregularly shaped spot at the tornus, white outline also present; "tail" black with white tip on both surfaces. Fringe generally white, but outer fringe around tornus dark brown. **Male genitalia:** Sclerites of 9th and 10th segments fused into a complete ring, with tegumen of two segments indistinguishable; uncus absent; socii folded deeply inwards; brachium single-articulated with tegumen, smooth, hook-like; saccus fairly short; phallus symmetrical, strongly upcurved; juxta platelike; valva semicircular, ampulla forming a long spine, harpal region bearing a slender process proximally, fused with the lobelike cucullus + valvula distally, costa prominent and elongate, sacullus relatively well developed with a solid ventral ridge. **Female genitalia:** Apophyses posteriores elongate, slender, with weakly sclerotized, somewhat square-shaped papillae anales; ductus bursa slender, heavily sclerotized; sterigma with lamella antevaginalis absent, lamella postvaginalis heavily sclerotized, forming a pair of spines projecting posteriorly; corpus bursa oval, bearing a pair of small, invaginated spinelike signa.

Biology of *Sibataniozephyrus*

The biology of *S. fujisanus* has been described in detail by Shirôzu and Hara (1960) and Fukuda et al. (1984). It will be briefly summarized below because both works are in Japanese. The exclusive host plants of *S. fujisanus* are *Fagus crenata* Blume and *F. japonica* Maximowiczi. Ovum is white and fairly large (diameter 1.00–1.02 mm, height 0.54 mm). It is laid singly on a twig and hibernates. The larva hatches in early spring when the host starts budding, and initially bores into buds. The fully grown larva is yellowish brown, reaching 16.5 mm. It makes a shelter by spinning two or three leaves together, and consumes young leaves and buds. Feeding usually takes place nocturnally. The pupa is uniform light brown with two rows of subdorsal dark dots. Pupation usually takes place under fallen leaves around the base of the host. *Sibataniozephyrus kuafui*, the new species described below, presumably feeds on *F. hayatae* Palibin ex Hayata because this butterfly is associated exclusively with this plant.

Sibataniozephyrus fujisanus (Matsumura)
(Figs. 23–27, 36, 37, 42–45)

Zephyrus fujisanus Matsumura 1910:221.
Zephyrus nohirae Matsumura 1915:1, pl. 1, fig. B.
Zephyrus attilia ab. *subgriseus* Wileman 1911:55.
Zephyrus fujisanus ab. *yamamotoi* Uchida 1932:232, tab. 16, fig. 5.
Zephyrus fujisanus ab. *zoasanus* Kanda 1933:8.
Favonius fujisanus; Sibatani & Ito 1942:327.
Quercusia fujisanus; Shirôzu & Yamamoto 1956:393.
Quercusia fujisanus latimarginatus Murayama 1963:48, figs. 31, 33, 35, 37. syn. n.
Sibataniozephyrus fujisanus; Inomata 1986:120 (synonymy).

TL. Mt. Fuji [Honshu, JAPAN].

Diagnosis. Male: Forewing length 16.0–18.0 mm (mean = 17.0 mm, n = 3); antennal length 8.0–8.8 mm (mean = 8.35 mm, n = 3). Forewing upperside bright metallic bluish green, margin dark brown; underside ground color yellowish white or white tinged with brown, all markings brown with a very stout transverse line adjacent and proximal to the submarginal spots. Hindwing upperside with coloration similar to that of forewing but with a much broader dark brown margin, its narrowest part still wider than the broadest part of the forewing margin, the white outline weakly developed; underside with the same ground color as forewing, discal band and discoidal bar separate, tornal patch yellow. **Male genitalia:** Ring-shaped sclerites of 9 + 10 segments width 0.56 times height; tegumen 9 + 10 forming a bump dorsally; brachium twisted; phallus with a short, stout aedeagus, length 1.1 times phallobase; valva with a short spine on ampulla, 0.2 times as long as entire valva, distal margin of the harpal region and ventral ridge of sacculus smooth, not serrated.

Female: FW length 15.0–17.2 mm (mean = 16.5 mm, n = 8); antennal length 7.0–7.8 mm (mean = 7.2 mm, n = 8). Both wings with upperside ground color uniformly brown, underside pale brown with an orange tornal patch, otherwise similar to male. **Female genitalia:** Lamella postvaginalis spines long and slender, each with a semicircular lateral lobe near the base, arranged nearly parallel to each other, with distance between the tip of the two spines approximately 0.19 mm; distance from the tip of the spine to ostium 0.53 mm; ostium width 0.01 mm.

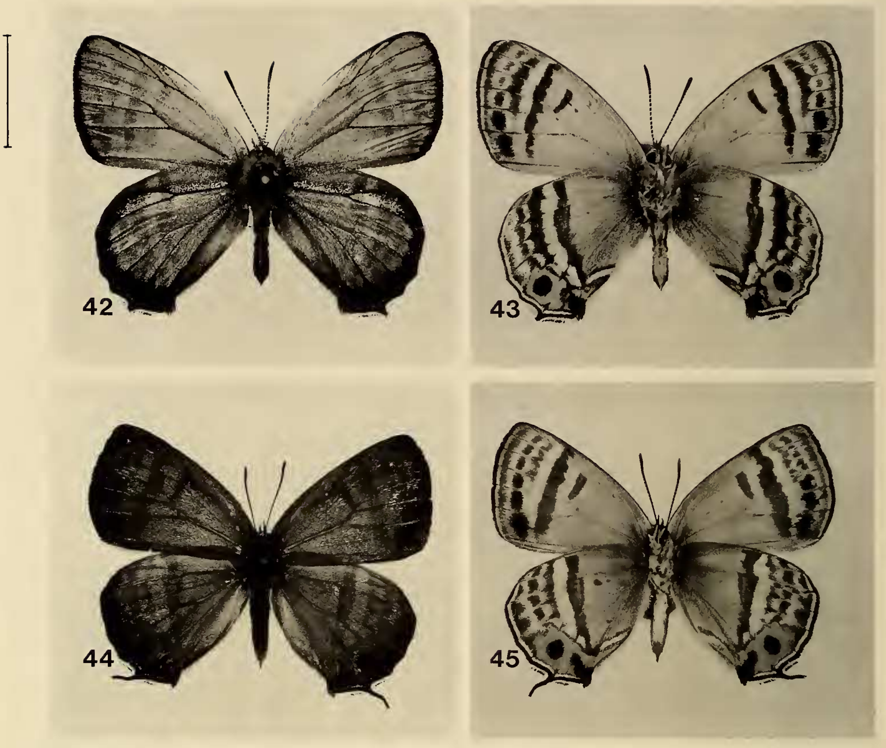
Species examined. JAPAN: 2♀, Honshu, Tottori Pref., Mt. Daisen, 25. VI. 1973 (T. Yuzuriha); 1♂1♀, same locality as above, 25. VI. 1983 (Y. Hama); 1♂2♀, Honshu, Kyoto Pref., Mt. Oe, emgd. 11. V., 15. V. and 27. V. 1983 (S. Kugo); 1♀, Honshu, Kyoto Pref., Tamba Town, Funai-gun, emgd. 10. V. 1977 (T. Yuzuriha); 1♀, Honshu, Kyoto Pref., Asauegun, Yamakawamachi, Mt. Kouetsu, emgd. 14. V. 1984 (T. Yuzuriha); 1♂, Yamanashi Pref., Tomurozawa, emgd. 15. V. 1984 (T. Yuzuriha); 1♀, Hokkaido, Kaminokunicho, Zentana, emgd. 3. VI. 1986 (T. Doi).

Geographical distribution. *S. fujisanus* is endemic to Japan (southern Hokkaido, Honshu, Shikoku, and northern to central Kyushu).

Comments. The populations in Kyushu, southern Japan, have been given subspecific status based upon two characters: the broader dark margin on upperside of the wings and the darker color on the underside of the wings. However, Inomata's (1986) discussion and numerous pictures of samples from various regions in Japan clearly reveal that variation within the two traits is continuous. The southern populations have a stronger tendency to show the two traits, but specimens indistinguishable from those from central Japan are encountered. This is clearly an example of clinal variation and in our opinion should not be recognized nomenclaturally.

Sibataniozephyrus kuafui Hsu & Lin, new species
(Figs. 28–32, 38, 39, 46–49)

Description. Male: Forewing length 16.1–18.6 mm (mean = 17.08, n = 24); antennal length 8.2–9.0 mm (mean = 8.5 mm, n = 24). Forewing upperside metallic dark blue tinged with green, margin black; underside ground color white with submarginal spots dark black, other markings dark gray, the proximal transverse line very slim. Hindwing upperside with the metallic area greenish blue with a purplish outline, margin black, not as broad as in *S. fujisanus*, the termenal outline distinct, forming a white line through entire termen; underside with the same ground color as of the forewing, discal band and discoidal bar always completely merged, not distinguishable from each other, tornal patch orange or yellowish orange. **Male genitalia:** Ring-shaped sclerites of 9 + 10 segments width 0.65 times height; tegumen 9 + 10 with dorsal side flat; brachium forming a simple hook, not twisted as in *S. fujisanus*; phallus with a long and slender aedeagus, length 1.4 times phallobase; valva with a long spine on ampulla, 0.3 times as long as entire valva, distal margin of the harpal region bearing 4 to 10 teeth (n = 9), number not always equal on opposite valvae, ventral ridge of sacculus heavily serrated.



FIGS. 42–45. *Sibataniozephyrus fujisanus* (Matsumura) (JAPAN, Honshu): **42,** ♂, upperside; **43,** ♂, underside; **44,** ♀, upperside; **45,** ♀, underside (scale line = 1 cm).

Female: Forewing length 16.0 mm (n = 1); antennal length 7.0 mm (n = 1). Both wings with upperside ground color dark brown and underside markings more developed than those in the male, otherwise similar to the male. **Female genitalia:** Lamella postvaginalis spines short and stout, no lateral lobe; the two spines widely separated, diverging, distance between tips of the two spines approximately 0.46 mm; distance from the tip of the spine to ostium 0.30 mm; ostium width 0.01 mm.

Type material. Holotype ♂, TAIWAN: Taipei Hsien, Sanhsia, Mt. N. Chatienshan, 1700–1727 m. 121°27′E, 24°47.5′N, 22. V. 1993 (Y. F. Hsu & M. Y. Lin) (NTUIM). Paratypes. 9♂1♀, same data as holotype (1♀ dissected: Genitalia YFH 0747); 14♂, same locality as holotype, 28/29. V. 1992 (9♂ dissected: Genitalia YFH 0441, 0442, 0447, 0487, 0498, 0499, 0500, 0501, 0502) (Y. F. Hsu & M. Y. Lin) (BMNH; CAS; IZASB; NTUIM; UCB; NMNH).

Depositories. Abbreviations of institutions are as follows: the Natural History Museum, London (BMNH); California Academy of Sciences, San Francisco (CAS); Zoological Institute of Academia Sinica, Beijing (IZASB); the Insect Museum, National Taiwan University, Taipei (NTUIM), Essig Museum of Entomology, University of California, Berkeley (UCB), and U.S. National Museum of Natural History, Washington, D.C. (NMNH).

Geographical distribution. *S. kuafui* is known from Taiwan.

Etymology. Kuafu is a character in Chinese mythology who tried to challenge the sun by chasing it until his exhausting death.

Comments. *Sibataniozephyrus kuafui* undoubtedly utilizes *Fagus hayatae* as its larval host in Taiwan because it is associated exclusively with this plant. *Fagus hayatae,* formerly

FIGS. 46–49. *Sibataniozephyrus kuafui*, new species (TAIWAN): **46,** ♂, upperside; **47,** ♂, underside; **48,** ♀, upperside; **49,** ♀, underside (scale line = 1 cm).

recognized as Taiwan endemic, recently has been reported from central China and was noted by Shen and Boufford (1988) as a remarkable new example of disjunction between Taiwan and central China. This discovery suggests that the population of *S. kuafui* in Taiwan may be a relict and suggests the possibility of finding this insect on mainland China. Shen and Boufford (1988) also point out that *F. lucida* and *F. hayatae* are more closely related to each other than they are to any other extant species of *Fagus*. According to Tsien et al. (1975:11), *F. lucida* is distributed approximately between 24°N and 30°N, which covers the latitudinal range where *F. hayatae* and *S. kuafui* are found in Taiwan. This fact makes *F. lucida* another candidate as a larval host for *S. kuafui*, or a possible sister species, on the Chinese mainland because this beech is apparently far more abundant than *F. hayatae* there.

CONCLUSION AND DISCUSSION

We conclude that *Sibataniozephyrus* should be considered a valid genus distinct from *Quercusia* on the basis of their phylogenetic relationship, biology, and biogeography. Each of these two genera retains several symplesiomorphic characters, while each has gained autapomorphic features. This phenomenon led early workers to lump them into a single genus.

We predict that *Sibataniozephyrus* will eventually be found on mainland China because China supports the richest diversity of both *Fagus* and Theclini in the world (Table 1). Moreover, it seems likely that more than one *Sibataniozephyrus* species may be present on mainland China based on the following observations:

1) There are multiple species of *Fagus* in China, and these species show various degrees of allopatry. Even when multiple species are sympatric, each species usually is dominant in a different topogeographical and horizontal zone (Tsien et al. 1975), which might favor vicariant speciation because relictual *Fagus* populations may function as isolated ecological and evolutionary islands.

2) Pollen studies reveal that *Fagus* species lived in many areas where they are absent today (Steenis 1971) indicating *Fagus* populations have suffered extensive extinctions in the past, which also may have led to vicariant speciation.

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